THE

HISTORICAL AND SCIENTIFIC SOCIETY

OF MANITOBA.

TRANSACTION No. 27.—SEASON 1886-7.

THE FOOT-STEPS OF TIME

IN THE

RED RIVER VALLEY,

WITH SPECIAL REFERENCE TO THE

SALT SPRINGS AND FLOWING WELLS TO BE FOUND IN IT.

BY

A. McCHARLES,

CHAIRMAN ARCHÆOLOGICAL COMMITTEE.

A PAPER READ BEFORE THE SOCIETY ON THURSDAY EVENING DECEMBER 16TH 1886.

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Of arrogance——
If, having walked with nature,
I now affirm of nature and of truth
—WORDSWORTH.

WINNIPEG:

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A. McCHARLES, WINNIPEG.

Mr. President, Ladies and Gentlemen:

In the Red River Valley, we have almost the two extremes of the geological scale, facing each other on opposite sides. The Laurentian or oldest rocks known in the world, encroach upon the eastern slope, and Cretaceous deposits form the uplands of the western escarpment, while the trough of the valley, including the great lake basin to the north, is occupied by several important belts of intermediate formations of various kinds. They all present a general northwest and southeast direction, in conformity with the old Laurentian coast line, and overlap one another on their outer edges, somewhat like rows of shingles on a roof; but they are of different thicknesses of course, and have very irregular widths to the weather, so to speak. For the laws of nature are opposed to equality in rock making as in everything else, and no two beds, outcrops or even layers are exactly alike in every way.

THE LAURENTIAN BELT.

The Laurentian belt or lowest rock-step in the ladder of time, is mainly a barren unproductive region here as elsewhere, and scarcely any land fit for settlement is to be found on it. Indeed, some parts of it might be aptly described as islands of granite in lakes of muskeg, but the most of it is thickly covered with timber of more or less economic value, such as poplar, birch, spruce, tamarac, jack pine and other native species, generally of small growth, but often large enough to be sawn into lumber for building purposes, the rest being very suitable for telegraph poles, railway ties, fence posts and fuel. The Winnipeg river and a score of other floatable streams

provide ample facilities for getting the timber out of the northern portion of it, and the Canadian Pacific Railway crosses the south part of it.

The whole Laurentian system, as you are aware, stretches all the way from Labrador, in a southwest course to Lake of the Woods, and then northwest to the Arctic ocean, being hollowed out like an elbow by Hudson's Bay. The narrow fringe of it extending into Manitoba, has only a breadth of fifty to one hundred miles at the American boundary line, but widens considerably towards the north, and forms the eastern shore of Lake Winnipeg nearly its whole length. These fundamental rocks are supposed to have been part of the original crust of the earth, and the granites among them were evidently in a fused state at one time, and formed at some unknown depth below the present surface of the globe, as they are seldom or never found in regular beds, like the sedimentary formations, but as a rule, in great unstratified masses inclined at all angles, and often fractured, dislocated, folded and tilled into every conceivable attitude, which indicates the tremendous forces by which they were thrown up. They also occur in veins or dykes penetrating other formations, but never overlying them like the volcanic traps. The process of cooling must have taken place before they were exposed to the open air as shown by the large size of their component crystals.

THE CAMBRO-SILURIAN BELT.

The junction of the Cambro-Silurian belt with the Laurentian series has not been accurately determined yet in Manitoba, and especially between the Winnipeg river and the international line. That part of the Province, though generally level, is of such a rough character on account of fallen timber, dense scrub and impassable bogs, that geological investigations are rather difficult to prosecute there. But as we approach the Red River Valley, the physical aspect of the country undergoes a great change. The bush disappears to a large extent, and we come upon a fine prairie region, undulating in long sweeps, and well adapted for stock raising and mixed farming—the pasturage being excellent and the soil exceedingly fertile. Its settlement has unfortunately been retarded by various artificial causes, such as the granting of 1,400,000 acres in the very heart of it to the half breeds shortly after the first rebellion, or about fifteen years ago, which was intended to benefit them and their children, but turned out to be one of the philanthropic abortions of history.

The most of the "claims" as they were called, soon fell into the hands of speculators, who held out for high prices while free homesteads could be got farther west. But since the collapse of the real estate boom here, these lands have been forced on the market and can now be purchased at less than half their actual value. We may therefore confidently expect to see this magnificent district properly settled in a few years, and instead of an almost desolate plain, to find comfortable homes, waving corn fields and herds of cattle on every section, "busy men with their pious steady husbandries making all things green and fruitful," as Carlyle would put it.

SUPERFICIAL DEPOSITS.

The rock beds of the Red River Valley are almost entirely concealed by a vast accumulation of loose materials, consisting mainly of boulder clay, gravel, sand, blue clay and black loam, or what we appropriately call the *ground*, as the most of it was originally made by the grinding action of immense glaciers that came down the valley from the north when that region was elevated far above its present level. These superficial deposits vary in depth from nothing to ninety feet or more, and if they were removed we would have, instead of level prairie, a very rough country, full of rocky hills and ridges, precipitous cliffs, deep chasms and ancient river beds—owing to the great inequalities of the surface of the underlying Laurentian rocks on which the sedimentary series rest. This is also the principal reason that flowing wells are invariably found on the west side of the city by going down from 50 to 75 feet, but never on the east side at any depth.

A section of one of these flowing wells shows the following beds:

	Feet.	Inches.
Black loam	2	7
Yellow-grey clay	6	3
Dark blue clay	29	2
Boulder clay	18	4
Loose gravel.....(to rock bed)	5	1
	61	5

The boulder clay is cemented together into a solid mass like concrete, and the well drillers call it hard pan. As soon as this compact bed is passed through, flowing water is always found on the west side, in a thin layer of gravel that occurs there right under it and resembles an old shore wash, but is absent on the east side, where the boulder clay rests immedi-

ately upon the rocks. The dividing line runs almost north and south near the central school. In one case, a strong current was struck after boring through a log of coarse-grained timber like oak lying on top of the gravel bed 52 feet from the surface, as if stranded on the beach, and bits of the wood, broken off by the drill, floated away on the water as it ran on the ground. Then, there is a sudden dip of the strata towards the river, and at the outer end of Point Douglas, the bed rock in the middle of the stream, is 112 below the general level of land.

ARTESIAN WELLS.

The question of our water supply being of more than ordinary importance, I have taken some trouble to gather all the available data on underground currents here. We have already over forty constantly flowing wells in the city. Their average depth is about sixty feet, but decreases gradually towards the west, as the rock beds come nearer the surface. The water shoots up at first from ten to fifteen feet, carrying gravel and sand with it for a few seconds, when it gets perfectly clear and of a bright sparkling color. A number of wells may be very close to each other, as on Young Street, without diminishing the quantity or force of the flow in any case. All these wells give out at least a million gallons of water daily, or enough to supply our present population with 50 gallons a head, which is the usual consumption of other cities, but the most of it is allowed to go to waste here.

As to the source from which the subterranean currents in the Winnipeg basin are derived, the prevailing idea that they are connected with the great lakes to the north or east, is obviously wrong, as will be seen if we only look at the relative elevations of the latter as compared with the site of the city, above the sea.

Winnipeg (market square)	765	feet.
Lake Winnipeg	710	"
Lake St. Martins	737	"
Lake Manitoba	752	"
Lake Winnipegoosis	770	"
Shoal Lake	over 800	"
Lake of the Woods	1,042	"

Now, it is quite evident that the supply cannot possibly come from either of the first three of these lakes, as they are all lower than the city, and if it came from Lake Winnipegosis, which is only five feet higher, there would not be sufficient pressure to force the water up ten feet as is done here. Then,

if it came from Lake of the Woods to the east, the water would rise over 250 feet above the ground anywhere in the Red River Valley. It may, however, come from Shoal Lake, which stands on a high table land, has no visible outlet, and is the nearest to the city; but in that case the water should be thrown up about fifty feet here. In view of these and various other circumstances, the most reasonable hypothesis with regard to the water supply of our flowing wells, is that it percolates through the surface on the long, gentle slope that stretches to the northwest of the city for twenty-five to thirty miles, and getting into the loose gravel bed that lies between the impervious boulder clay and the solid rocks, it acquires enough pressure towards the foot of the slope here to force it up as we see. The currents run in from that direction at all events, but turn southward in the middle of the city, on reaching the eastern limits of this gravel aqueduct (which is probably connected with the gravel ridges west of Stonewall), and appear again in a flowing well in Fort Rouge, at the same depth as on this side of the Assiniboine river.

Of course, the rock beds of the globe are estimated to hold about as great a volume of water as the ocean, and everybody knows that in rocky districts running springs are always to be met with. This wide and general distribution of fresh water on or near the surface of the earth is significant of the grandest design, to say the least of it—being almost as necessary as light and air for both man and beast. But the water of our flowing wells, as I have shown, is not found in the rocks here, but running over them as on a floor, perhaps because it is the hard-close-lying dolomite beds of Stony Mountain, and not the porous limestones of Selkirk East, that extend under the city, and they have been penetrated in many places from 50 to 200 feet without obtaining water in any quantity, to speak of, and which has to be pumped out.

The water of these flowing wells contains a very large percentage of solid matter in solution, even more than the river water, as it runs over a magnesian limestone bed, and when used in factories it forms a thick coating on the inside of the boilers in a few days. But water is not impure or dangerous to health in proportion to the solid ingredients it may hold, but depends on the amount of organic matter in it, and in this respect the flowing wells furnish the best water we have here.

As to our water supply for the future it must apparently be brought from Lake of the Woods or from some point on

the Winnipeg river near the rapids, which is only about 60 miles to the northeast of the city, with very few engineering difficulties of any kind on the way, and a natural fall of over fifty feet.

SELKIRK QUARRIES.

As already stated, the rock bottom of the Red River basin is covered by alluvial and other deposits of an average depth of about fifty feet. But commencing somewhere near Tyndall station on the Canadian Pacific Railway, a short line of disturbance runs across the valley in a western course, along which the limestone beds come to the surface in many places and several quarries have been opened out. This disturbed belt, as far as I could ascertain in a hurried investigation, is over seven miles wide at Selkirk East, and also where the Red River crosses it at St. Andrews rapids, which are caused by it. But the rock beds, though elevated more or less over the whole area, do not seem to be thrown out of position except at certain points, where they were probably thin and weak, and in some cases only the first three or four layers are broken up and displaced, while resting apparently on undisturbed strata.

At Selkirk East, two quarries have been worked somewhat extensively for a number of years, one at each end of a large mound about half a mile in length, and most of the ornamental stone used in the city has been taken from there. It is pure limestone, of a beautifully mottled color, in which light-grey and yellow spots are so finely blended as to look when dressed almost like vermiculated work. Great blocks of it, with sharp unworn angles, and from eighteen inches to four feet in thickness, are found in these quarries or pits among the boulder clay, but the cost of "stripping" the so-called beds, or getting the stone out, makes it rather expensive for general building purposes. The overlying drift is clearly stratified, not only on the surface, but also in the spaces between the detached rocks, sometimes to the depth of fifteen to twenty feet, which may indicate that the upheaval took place towards the close of the glacial period.

Then on section six, in township thirteen and range six, about five miles to the southeast of Selkirk station, there is a natural exposure of similar strata, in two small hopper-shaped holes close to each other at the junction of a low marsh with one of the gravel ridges that are so common in that locality. The stone is thinner-bedded and therefore broken into smaller blocks than at the Selkirk quarries, though otherwise the

same in every respect. But this outcrop is seldom worked, as it is usually under water in ordinary seasons.

FOSSIL REMAINS.

The most extraordinary feature of the Selkirk bed, on the geological side, is the great number, variety and size of the fossil remains to be found in it. From a very small portion of the stone quarried there in the past four years, I have incidently collected hundreds of fine specimens, referable mainly to the following genera:

ZOOPHYTA (Corals).

Stromatopora; three kinds and very common throughout the bed in large bands and nodules.

Receptaculites occidentalis; exceedingly numerous, and from two to fifteen inches in diameter, but always in the shape of a sun-flower, as the quarry men call it.

Columnaria alveolata; quite abundant in several forms of structure.

Halysites catenulatus; in any quantity, and some beautiful specimens have been obtained of it.

Streptelasma corniculum; four varieties and frequently met with—as well as many other species of coral.

CRUSTACEA (Trilobites).

Asaphus platycephalus; two magnificent specimens, one of them doubled up, with spine-like processes on the dorsal side.

Ceraurus; five species, but only the glabella found in any case.

Illaenus; three fragments—and a variety of other forms.

GASTEROPODA (Snails).

Lituites undatus; rare, but got a section of an uncommonly large specimen with three whorls, and a complete one of smaller size.

Maclurea; four different types, but not very numerous; one specimen is over nine inches in diameter and exceptionally fine.

Pleurotomaria; four species, but comparatively scarce.

Murchisonia; three forms, and more abundant; one seven inches long with ten rings.

Helicotoma; two specimens of different sizes, but apparently the same kind.

Subulites; one, complete but small.

BRACHIOPODA (Bi-valve shells).

This sub-kingdom is represented very slightly.

Strophomena; few, and fragmentary as a rule.

Rhynchonella; two forms, also rare.

Orthis; three species, generally obscure. Complete specimens of either hard to find.

CEPHALOPODA (Cuttle-fish).

Orthoceras; three species, in great numbers, and frequently of enormous size.

Endoceras; four types, and equally common; one specimen about two feet long and four inches in diameter, with the test or shell remarkably well preserved and very finely ribbed.

Ormoceras; still more abundant in several forms; septal rings generally straight but sometimes oblique; one mere fragment over three feet long.

Phragmoceras; two species, but seldom met with.

Cyrtoceras; more numerous, and found three forms of it.

You will have noticed that the fossil life of this bed takes an unusually wide range, and embraces many of the forms that characterize the whole Silurian system, but the predominant species belong chiefly to the Trenton formation of it.

ALONG THE RAPIDS.

The same rock beds crop out on the banks of the Red River at several points between Lower Fort Garry and the head of the rapids, generally in horizontal position, but close to low water line. The largest exposure is right in front of the fort, where the beds come nearest the surface, on a depressed ridge that sweeps across the country there. Stone for different local purposes have been quarried or taken out in many places along the rapids, and the beach is thickly strewn with limestone boulders, which the settlers gather up and burn into lime in old-fashioned kilns, built on the upper edge of the river banks and looking in the distance like sparrows' nests on a wall.

A little above the rapids, or near the southern limits of the disturbed belt, there is another exposure, known as "The Bishop's quarry." This outcrop presents some new features, and is probably a transition bed between the Selkirk East and Stony Mountain formations. It consists of a strong, close-grained limestone, of a uniformly dull brown color, and is almost destitute of organic remains. I have only found one obscure fossil in it—the siphuncle of a small cuttle-fish. The

stone takes a very good finish, but is rather "plucky," or apt to chip off beyond the desired lines in dressing it.

The fall of the river in crossing the rapids is only about twelve feet, and from Winnipeg to the lake twenty-one feet, in low water.

STONY MOUNTAIN.

From the rapids westward for twelve miles the country is quite level, with no signs of disturbance on the surface, when Stony Mountain rises abruptly over fifty feet above the surrounding prairie, like an island in the sea. It covers an area of three square miles, and has the shape of a mammoth horse shoe. The rock beds are exposed on its north and west sides almost continuously, with projecting cliffs of a reddish color here and there, on which the old shore lines of some ancient sea or lake are distinctly traceable; but it runs out towards the south into gravel ridges on both arms.

A section near Macalister's quarry shows the following strata in descending order:

	Feet	Inches.
Black loam	—	8
Gravel and sand	2	3
Yellowish-grey dolomite	31	6
Limestone shales of a purple color	7	4
Measures concealed by detritus	15	—
	56	9

The upper bed is fine magnesian limestone or dolomite of very firm texture, and specially adapted for railway bridge work and rubble walls. It can be quarried easily as there is little or no stripping to be done, and the stratification varies from a few inches to two feet. This outcrop belongs to the Niagara formation, and rests on Hudson River shales. It contains hardly any remains of animal life. In the first two or three layers, however, obscure casts of fossils are often to be seen, and specimens of *Columnaria alveolata, Petraia corniculum Beatricea nodulosa, B. undulata* and *Rhynchonella capax* are occasionally met with, though usually in a half decayed state.

But the lower bed is exceedingly fossiliferous, being almost a regular mass of corals, bi-valve shells and snails. The following species are the most abundant in it.

ZOOPHYTA (Corals).

Chætetes; two forms and very fine.

Columnaria; in large saucer shaped nodules, and sometimes with ripple marks on the convex side.

Streptelasma; remarkably numerous, but generally of small size.

Zaphrentis; a peculiar fossil with three lobes, somewhat rare.

GASTEROPODA (Snails).

Murchisonia; two types and frequently met with.
Pleurotomaria; very common, in five different forms.

BRACHIOPODA (Bi-valve Shells).

Orthis; four species, in countless numbers.
Rhynchonella; three forms, and almost as common.
Strophomena; two varieties, and very numerous also.

CEPHALOPODA (Cuttle-fish).

Orthoceras; three distinct species, but rarely found, and only fragments in every case.

About seven miles to the south-west of Stony Mountain, at a place called in contrast Little Stony Mountain, which is merely a small anticlinal ridge, the same dolomite bed is barely covered by a thin coating of limestone gravel, and a very fine quarry has been opened there. It also extends under the City of Winnipeg, at a depth of fifty to one hundred feet, as already pointed out.

STONEWALL.

There is a slight depression immediately around Stony Mountain, but a few miles farther to the northwest, at Stonewall, on a gradually rising slope, which attains to a greater height than even the top of the so-called mountain, a bed of coralline dolomite of a light grey color approaches the surface over a large area, and a quarry is worked now and again near the railway station there. It has been generally assumed that the two beds are identical and belong to the same Niagara formation, but the whole evidence goes to show that the Stonewall bed occupies a higher geological position, corresponding with the Guelph formation in the east. It is perhaps worth noting in this connection that the Stony Mountain stone weathers to a rusty red, and makes a strong grey lime, while the Stonewall stone changes on exposure to cream color, and makes a weak but very white lime, used by plasterers for kalsomining and the finishing coat. But the best proof is the marked difference in the fossil remains of the two beds. In the former outcrop, we have seen that only a few obscure species are to be found, but in the latter a great num-

ber of other forms occur, that always characterize the upper Silurian series. For instance, the following types, which are very common in it :

ZOOPHYTA (Corals).

Favosites gothlandica.
Stromatopora concentrica.
Receptaculites occidentalis.
Chætetes lycoperdon.

GASTEROPODA (Snails).

Pleurotomaria solaroides.
P.——— perlata.
Murchisonia bivittata.
M.——— Loganii.
M.——— Boydii.
M.——— bellicincta.
Subulites ventricosus.
Cyclonema sulcata.
Loxonema Fitchi.

BRACHIOPODA (Bi-valve Shells).

Pentamerus occidentalis.
P.——— galeatus.
Atrypa recticularis.
Orthis eminens.
O.——— subquadranta.

CEPHALOPODA (Cuttle-fish.)

Orthoceras tenuiseptum.
O. ——— longicameratum.
O.——— lamellosum.
Endoceras proteiforme.

Of the corals, *Favosites gothlandica* is particularly abundant in the Stonewall bed; and some layers are thoroughly honeycombed with it. The snails are generally small, but well preserved, with the surface very smooth and clean.

Of course, this mistake would be of little consequence, only for the important bearing it has on the probabilities of a salt bed existing to the northwest of Stonewall, in the district around Lake Manitoba, as will be shown further on.

THE DEVONIAN BELT.

In the western portion of the Red River valley, the Silurian series are followed in regular order by a narrow Devonian belt, but the exact line between them, or where they meet,

has not been fully defined yet. South of the lake region, I have not seen or heard of any rock outcrops on it, being throughout very level prairie. Near Westbourne station, I secured a few fossils, such as *Zaphrentis prolifica*, *Michelinia convexa*, and *Pentamerus oratus*, from which it would appear as if the deposits there belonged to the lower division of the system. But as these organic remains were found in river boulders that might have been transported from a distance by the ice, they cannot be relied upon to tell a true story.

SALT SPRINGS.

The feature of most interest in connection with this belt is a number of saline springs that rise to the surface in different parts of it. Even as far south as the Mennonite settlement the well water tastes so "salty," as the farmers say, that it is scarcely fit to drink, as a rule, and in boring an artesian well at Rosenfeld for the Canadian Pacific Railway, the farther down they went the more brackish the water became, which shows that it is not owing, as might be supposed, to any alkali infiltrations from the surface. But the salt bed that causes it, does not apparently extend to that district, as the well referred to was sunk over eleven hundred feet without meeting any other signs of the presence of rock salt.

The most remarkable spring of this kind that I have met with is on the east half of section one, in township fourteen and range ten west, near Woodside, on the north bank of the White Mud river, where brine of considerable strength bubbles out in such quantity as to form a constant stream two feet wide and four inches deep, running from it the year round, for it never freezes up. This spring is very advantageously situated for manufacturing purposes, being close to the railway track, and surrounded by bluffs of excellent timber for fuel, such as oak and elm of large size. Then the dry, absorbing nature of the atmosphere, and the prevalence of bright sunny weather here, are the most favorable conditions for making solar salt, which is produced by natural evaporation in the open air, and is incomparably the best for curing meat and fish.

There is another large spring of somewhat weaker brine on the west bank of the Red River, about thirteen miles south of this city, and springs of much stronger brine occur at the north end of Lake Manitoba, that form incrustations of salt around their edges and on the limbs of the adjacent trees. I boiled down some of the Woodside brine in a tin pail on my office

stove, and it made a coarse pungent salt of a fairly white color, without any attempt to purify it.

The geological character of that part of the country is greatly in favor of the existence of a salt bed there. In New York State and Western Ontario the saliferous rocks, as they are called, belong to the Upper Silurian series, and rest upon the Niagara limestones, which we have here at Stony Mountain. Then in Ontario the intercalated Guelph formation, which is wanting in New York State, constitutes the lower subdivision of the salt group, and it crops out at Stonewall here, as I have endeavored to prove, in the same stratigraphical position. To the northwest of Stonewall the measures are concealed for a long distance by the drift, but as we gradually rise step by step in the geological scale, in crossing the Red River valley from east to west, it is not unlikely that the next or Onondaga formation, in which the salt beds and brines are found in the East, occurs there.

THE CRETACEOUS BELT.

The highlands of the western slope of the Red River Valley, as already mentioned, are covered to a great depth by Cretaceous deposits, made up of various shales and thick beds of dark blue clay, which is nearly as compact as hard pan, but crumbles on exposure to the weather and turns to a dirty grey color. There is a wide gap, as you are aware, in the rock series here, and this formation is relatively five epochs younger than the Devonian strata immediately below it. Modern trees, plants and flowers make their first appearance in it. I found a pine (conifer) knot and other pieces of wood at a depth of 198 feet in the clay, on the Riding Mountains—but nothing else of special interest, except a few of its commonest fossils, such as the *Inoceramus*, a fragment of a *Baculite* and a complete specimen of *Scaphites subglobosus*, with the shell in a perfect state.

NO INTRUSIVE TRAPS.

The sedimentary rock beds of the Red River Valley have been violently disturbed at several points, like Selkirk East and Stony Mountain, by subterranean forces of some kind, or possibly by a slight local contraction of the earth's crust, but they are not intersected anywhere that I know of by eruptive rocks, and we may therefore infer that no volcanic outbreaks took place within the valley after the Silurian age.

SURFACE BOULDERS.

There are very few surface boulders here. But a great many have been exposed in the river beds this season on account of the water having been unusually low. The most of them are limestone, and the farther south the more rounded they become; for boulders like men, get their angles rubbed off by travelling away from home. I have seen it stated that the field boulders occasionally met with on the prairie, were probably lifted out of the river channels by the ice, and carried on the land in this way; but anyone acquainted with the habits of our rivers, must know that the ice, even in flood years, breaks up and goes down stream, as a rule a week or ten days before ordinary high water mark is reached, much less flooding point.

A very fine display of boulders, however, is to be seen in Southwestern Manitoba, on the Lake of Killarney, which has a regular embankment of granite boulders three or four feet high around two sides of it, close to the water's edge. They are piled up as evenly as if done by hand, and constantly follow all the windings of the shore. So that every visitor to this beautiful spot can choose his own blarney stone, if he likes.

FOSSIL FAUNA.

The fossil remains of the Red River Valley are exceedingly numerous and interesting. So far, with very little effort, I have obtained one hundred and five different species; of which nineteen are corals, twenty-three brachiopods, fifteen crustaceans, twenty-seven gasteropods and twenty-one orthoceratites. Some of the corals and cuttle-fish are persistent throughout the whole Silurian series, such as *Columnaria alveolata* and *Orthoceras tenuiseptum*, also a few of the bi-valve shells

GLACIAL ACTION.

Where rock outcrops are so scarce and often disturbed, it is rather difficult to find many reliable traces of glacial action. But at Stonewall and Stony Mountain the markings in some cases are very plain, and indicate a northwest and southeast course, which is likewise the general direction of nearly all the gravel ridges in the valley.

ECONOMIC MINERALS.

It is quite probable that the mineral belt which forms the southern margin of the Laurentian system around Lake Superior, continues along the east side of Lake Winnipeg, and that

important discoveries of gold and silver will yet be made there.

Iron ores. On Big Island in Lake Winnipeg, there is a great vein of hematite iron ore, which has been practically tested in Chicago, and proved to be of excellent quality, yielding from 45 to 63 per cent of iron. A large bed of bog iron ore occurs in the same locality, and ochre paints could be made from the superficial materials associated with it.

Petroleum. There has been a good deal of exploring done this season for petroleum in the Riding Mountain district, and it was reported in the press a few months ago that several parties had "struck oil" there, but nothing more has been heard about it since then. Although the surface indications are rather faint, it might be worth while to test the matter thoroughly, as the geological conditions are somewhat analogous to those of the petroleum region on the Athabasca river.

Salt. In the olden time all the salt used in the country was made here, from the natural brines already described, by the most primitive methods, and with the freight from Ontario at $1.12 a barrel, it ought to pay handsomely to manufacture salt here. That a regular salt bed exists in the neighborhood of Lake Manitoba is more than likely, but how far from the surface can only be ascertained by boring in the usual way.

Gypsum. A number of gypsum bands occur in the same district—not of the common kind, but of a fine translucent variety called selenite, which makes superior plaster of Paris when calcined. A leading plasterer here, who has tried it, says he has never seen as white a sample anywhere else.

Pottery clays. Very good pottery can be made by mixing one fourth of the yellow-grey clay of the modified drift with the blue clay beneath it, but they require an outer coating of a species of clay to be found near Shoal Lake in order to take a glazed finish.

Moulding sand. At Melbourne station on the line of the Canadian Pacific Railway there is a thin bed of moulding sand of very fair quality, with plenty of body, and yet sufficiently open to let the air escape without venting, which is a great advantage as it gives the castings a clean surface free from bubble marks.

BUILDING MATERIALS.

Stone. Very few cities in Canada are more fortunate than Winnipeg in regard to building materials. The Selkirk East stone is admirably suited for the finer classes of work, and at Stony Mountain there is an inexhaustible supply of excellent

stone for bridges, culverts, dimension, flags, curbing and foundations of all kinds. The prospective value of these quarries can hardly be imagined, as no other workable bed of building stone is known to occur for nearly a thousand miles on the great plains to the west, and this must be a country of frost-proof cellars to store vegetables in during the winter months, if for nothing else.

Brick. The yellow-grey clay that underlies the black loam of the prairie almost everywhere in the Red River Valley, makes very good brick of a pleasant cream color. But in some places the top of the bed is affected by contact with the rich soil above it, and should be mixed with the lower part, which usually contains a larger percentage of sand. It is wrought extensively for the manufacture of brick at Winnipeg, St. Boniface, Stony Mountain and many other points.

Lime. Three kinds of lime are made here. The Selkirk East stone yields a mellow grey lime, which is preferred for common plastering, and by some builders for brick work, but it air-slacks very fast, and particularly in hot weather. The Stony Mountain dolomite produces a very strong greyish lime, suitable for all ordinary purposes; and the Stonewall bed makes a remarkably white lime for finishing work.

Sand. Thin bands of water-worn sand are met with in Bird's Hill and other gravel ridges, but the river sand is by far the best for making both mortar and plaster, and a fine bed of it occurs within the city limits, on the extreme end of Armstrong's Point. There is exactly the same advantage in using sharp instead of round sand, as in using square instead of round stone in building a wall. The particles fit closer to each other, and therefore require less lime, while making a stronger and better job in every way.

CONCLUSION.

But I must not trespass any longer on your patience. The facts I have endeavored to lay before you, and what is known of the extensive coal fields of Alberta, the petroleum and salt deposits of the Athabasca district, the gold of the North Saskatchewan river—not to mention the Rocky Mountain region—warrant the general conclusion, that, besides the rich prairie soil, which is so easily made subservient to the wants of man, we have in the Canadian Northwest and especially in the great palæozoic belt that extends from the Red River valley to the Peace River country or beyond it, a vast storehouse of mineral wealth, prepared by a wise, beneficent Creator against the time when the world should have need of it.